TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
1.1	Purpose of Study	1
1.2	Authority and Acknowledgments	1
1.3	Coordination	2
2.0	AREA STUDIED	2
2.1	Scope of Study	2
2.2	Community Description	2
2.3	Principal Flood Problems	4
2.4	Flood Protection Measures	4
3.0	ENGINEERING METHODS	4
3.1	Hydrologic Analyses	4
3.2	Hydraulic Analyses	5
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	6
4.1	Flood Boundaries	6
4.2	Floodways	6
5.0	INSURANCE APPLICATION	8
5.1	Reach Determinations	8
5.2	Flood Hazard Factors	9
5.3	Flood Insurance Zones	9
5.4	Flood Insurance Rate Map Description	11

TABLE OF CONTENTS (Continued)

		Page
6.0	OTHER STUDIES	11
7.0	LOCATION OF DATA	11
8.0	REFERENCES AND BIBLIOGRAPHY	11

FIGURES

Figure 1 - Vicinity Map 3

Figure 2 - Floodway Schematic 8

TABLES

Table 1 - Summary of Discharges 5

Table 2 - Floodway Data 7

Table 3 - Flood Insurance Zone Data 10

EXHIBITS

Flood Profiles

Scioto River Panel 01P

Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map

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FLOOD INSURANCE STUDY

CITY OF CHILLICOTHE,
ROSS COUNTY,
OHIO

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Chillicothe, Ross County, Ohio, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared originally for purposes other than the National Flood Insurance Program. The data were identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. The Federal Emergency Management Agency (FEMA) performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the National Flood Insurance Program. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, Federal Emergency Management Agency, Chicago, Illinois, for consideration for revision of this study.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), Huntington District. The hydraulic analyses to determine the flood elevations for this study were performed by the COE based on the following studies: "Flood Plain Information: Scioto and Olentangy Rivers, Ohio, Main Report," "General Design Memorandum for

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the Chillicothe Local Protection Project," and "Central Ohio Survey: Scioto River at North Chillicothe, Ohio" (References 1-3). The floodway analysis was performed by FEMA based on the COE hydraulic analyses.

1.3 Coordination

On July 11, 1983, the results of this study were reviewed and accepted at a final coordination meeting attended by representatives of the community and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Chillicothe, Ross County, Ohio. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected based on the extent and validity of available existing hydrologic and hydraulic data.

The Scioto River was studied in detail within the corporate limits. Paint Creek was originally studied by detailed methods from about 0.25 mile downstream of the Norfolk Southern Railway to about 4,700 feet upstream of Paint Street, but due to a lack of detailed information about new hydraulic structures, this area has been delineated as approximate flooding.

Approximate methods of analysis were used to study all remaining areas having a potential flood hazard that did not have detailed scientific or technical data available.

2.2 Community Description

The City of Chillicothe is located in central Ross County in south-central Ohio, about 40 miles south of the City of Columbus. Chillicothe is surrounded by the unincorporated areas of Ross County. The 1980 census reported the population of Chillicothe to be 23,420 (Reference 4).

The temperature at Chillicothe varies from about 33.4 degrees Fahrenheit (F.) in January to 75.8 degrees F. in July. The average annual rainfall is about 39 inches and the average snowfall is about 18 inches (Reference 5).

The Scioto River basin has three distinct sections: a high, flat, poorly drained plateau section in the headwaters, a gorge section with narrow valleys from Delaware to Columbus, and an alluvial section with wide flood plains and rolling uplands south of Columbus. Chillicothe is located in the uplands section at the limit of glaciation in the Scioto River basin (Reference 1).

Most of the flood plain along the Scioto River is woodland, but some flooding occurs in urban areas. The flood plain of Paint Creek affects urban and industrial areas.

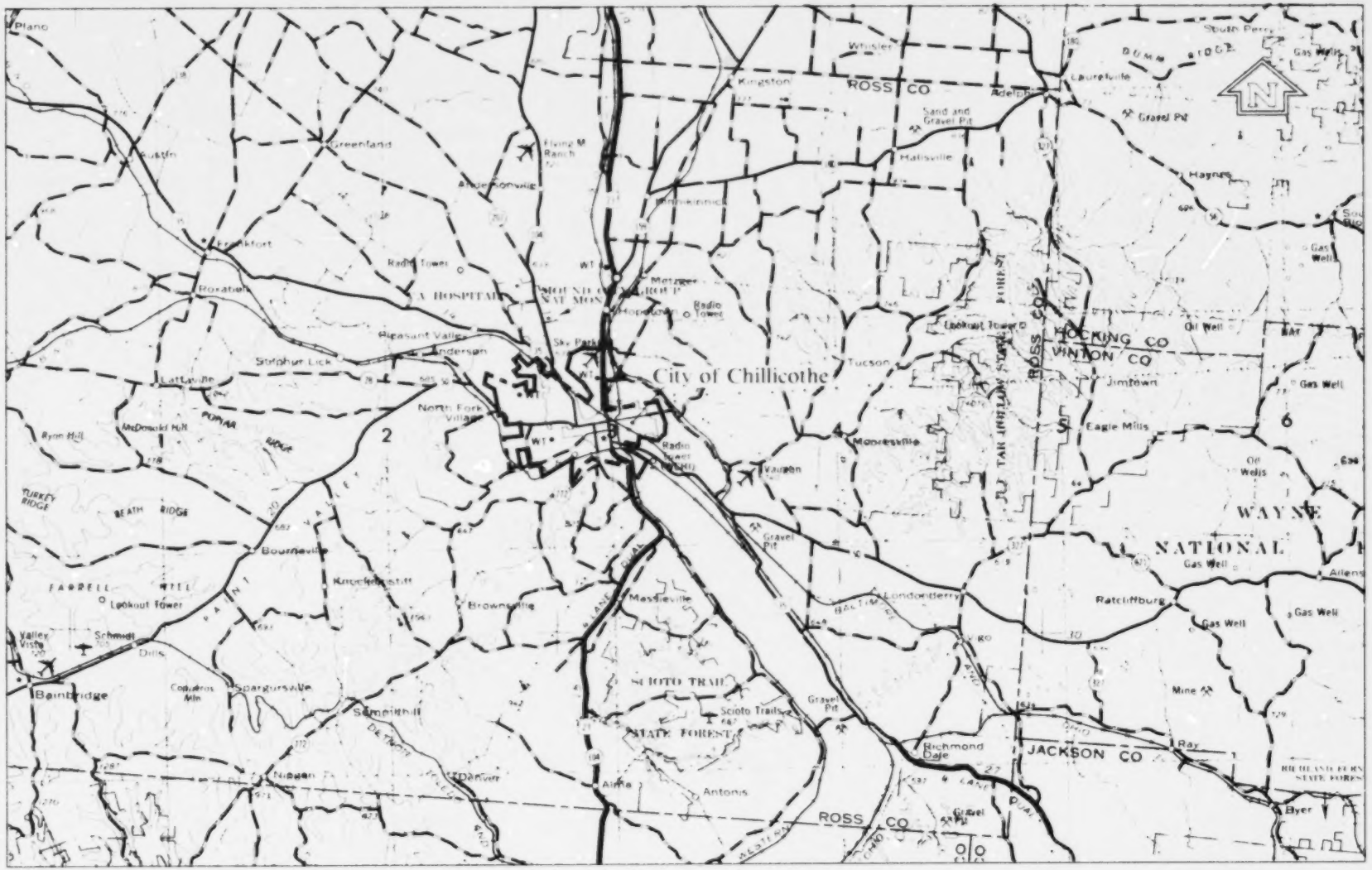

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CHILLICOTHE, OH
(ROSS CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

2.3 Principal Flood Problems

The Scioto River and Paint Creek experienced major flooding in March 1913, January 1959, and January 1937. The most severe of these was the 1913 flood. The peak discharge for the 1913 flood was 255,000 cubic feet per second (cfs) on the Scioto River at Chillicothe. The 1959 and 1937 floods had peak discharges of 144,000 cfs and 88,700 cfs, respectively. Paint Creek had its greatest floods of record in March 1963 and March 1964. These spring floods were the result of very heavy rainfall. The 1913 flood was also a result of rapid snowmelt (Reference 1).

2.4 Flood Protection Measures

Three reservoirs, Delaware, Alum Creek, and Deer Creek, offer flood protection for the Scioto River at Chillicothe. These reservoirs are located upstream of Chillicothe in the Scioto River basin, and provide protection in the form of reduced discharges for the 10-, 50-, and 100-year floods. The Paint Creek Reservoir located upstream of Chillicothe reduces discharges for the 100-year flood on Paint Creek. The greatest protection for Chillicothe is provided by the Local Protection Project, which is comprised of a series of levees placed along the right bank of the Scioto River. This project provides complete protection from the 100-year flood for the south bank of the river. The levee has more than 3 feet of freeboard above the 100-year flood and is certified to provide protection from the 1913 flood, which had a recurrence interval of 350 years.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

Discharge-frequency relationships for the Scioto River were developed by statistical methods using discharge data from gaging stations located throughout the basin (Reference 6). The principal gage used in this report is

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the U.S. Geological Survey (USGS) station at river mile 69.9 (in Chillicothe) on the Scioto River (Reference 3). A record of 75 years at this gage was used in the hydrologic analyses.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SCIOTO RIVER at river mile 69.9	3,849	66,000	111,000	136,000	217,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations on the Scioto River of floods for the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program (Reference 7). This hydraulic model was calibrated to the USGS gage at Higby and Chillicothe. The channel roughness coefficients (Manning's "n") varied with the selected recurrence interval. For the 100-year flood, the roughness coefficient ranged from 0.04 to 0.05 in the channel, and from 0.06 to 0.08 in the overbank areas.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

Areas of the community protected by levees are subject to potential risk due to possible failure or overtopping of the levee. These areas were delineated by applying the 500-year elevation determined from the "without levee" analysis.

An approximate analysis for Paint Creek was performed by normal depth calculation (Reference 8).

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations shown on the profiles are, thus, considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929.

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4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100-year flood plain boundaries have been delineated using topographic maps at scales of 1:24000 with contour intervals of 20 feet (Reference 9).

The 100-year flood plain boundaries are shown on the Flood Insurance Rate Map. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The floodway for the Scioto River was computed based on equal conveyance reduction and refined using engineering judgment. The results of these computations were tabulated at selected cross sections and are presented in Table 2, Floodway Data.

As shown on the Flood Boundary and Floodway Map, the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and the 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway of the Scioto River lie outside the corporate limits.

The area between the floodway and the 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
SCIOTO RIVER								
A	69.15	1100[2]	23,450	5.8	622.3	622.3	622.9	0.6
B	69.49	1800[2]	34.246	4.0	623.3	623.3	624.1	0.8
C	69.85	1900[2]	34,704	3.9	624.2	624.2	625.1	0.9
D	70.25	2300	48,070	2.8	625.9	625.9	626.8	0.9
E	70.41	2050[2]	43,277	3.1	626.1	626.1	626.9	0.8
F	70.54	1750[2]	38,022	3.6	626.3	626.3	627.2	0.9
G	70.89	1400[2]	33,346	4.1	627.4	627.4	628.3	0.9
H	71.08	1600[2]	26,810	5.1	627.6	627.6	628.5	0.9
I	71.32	2300[2]	32,105	4.2	628.2	628.2	629.1	0.9
J	71.76	2874[2]	52,817	2.6	629.1	629.1	630.1	1.0

[1]MILES ABOVE MOUTH
[2]THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CHILLICOTHE, OH

(ROSS CO.)

FLOODWAY DATA

SCIOTO RIVER

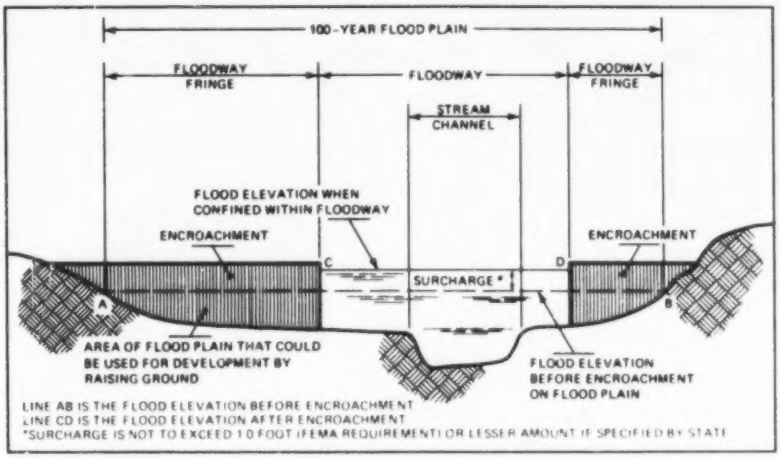
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 2 - Floodway Schematic

The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Chillicothe.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the weighted average difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the riverine flooding sources of the City of Chillicothe are shown on the Flood Profiles and summarized in Table 3, Flood Insurance Zone Data.

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5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a riverine reach is the weighted average difference between the 10- and 100-year flood water-surface elevations rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code. For example, if the difference between elevations is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zone A19:	Special Flood Hazard Areas inundated by the 100-year flood, with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- and 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3, Flood Insurance Zone Data.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
SCIOTO RIVER REACH 1	0005	−9.3	−2.9	8.6	095	A19	VARIES—SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CHILLICOTHE, OH
(ROSS CO.)

FLOOD INSURANCE ZONE DATA

10

SCIOTO RIVER

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Chillicothe is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines for riverine flooding sources show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Due to new hydraulic structures that lower the base flood elevations and discharges on the Scioto River, this Flood Insurance Study supersedes the COE report "Flood Plain Information: Scioto and Olentangy Rivers, Ohio, Main Report" (Reference 1), the COE "General Design Memorandum for the Chillicothe Local Protection Project" (Reference 2), the COE "Central Ohio Survey: Scioto River at North Chillicothe, Ohio" (Reference 3), and the COE Open-File Report, "Flood Hazard Evaluation Data" (Reference 8).

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the City of Chillicothe (Reference 10).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, 300 South Wacker Drive, Chicago, Illinois 60606.

8.0 REFERENCES AND BIBLIOGRAPHY

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9. U.S. Geological Survey, 7.5 Minute Series Quadrangle Maps of Ohio, Scale 1:24000, Contour Interval 20 feet: Chillicothe East, Ohio, 1975.

10. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Chillicothe, Ross County, Ohio, August 1979.

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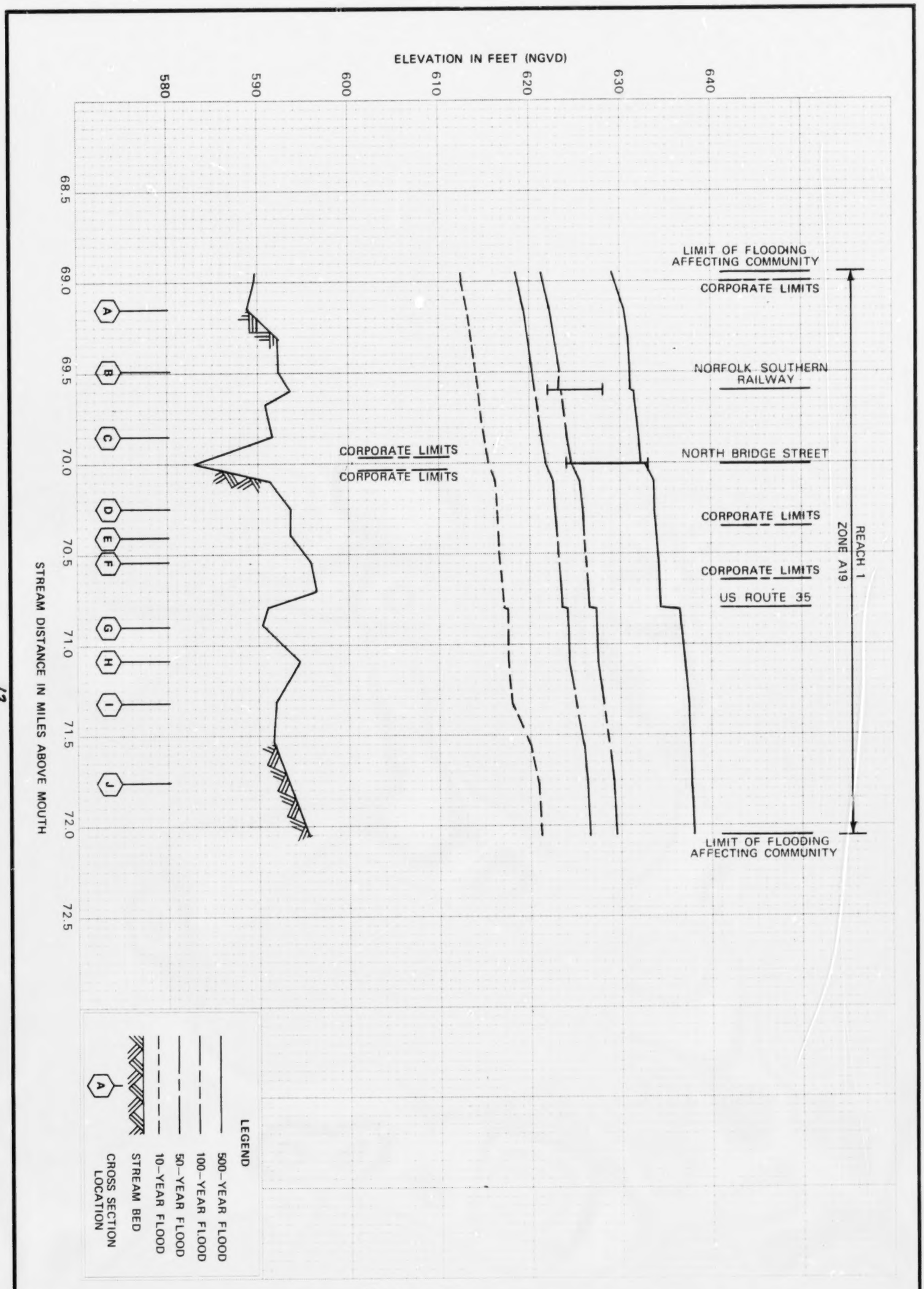

13

01P	FEDERAL EMERGENCY MANAGEMENT AGENCY **CITY OF CHILLICOTHE, OH** (ROSS CO.)	**FLOOD PROFILES** **SCIOTO RIVER**